UV-light driven photo-epoxidation of propylene into a fluidized bed reactor

N. Morante[a], V. Vaiano[a], L. De Guglielmo[b], G. Di Capua[c], N. Femia[b], D. Sannino[a]

[a] *Department of Industrial Engineering, University of Salerno, Via Giovanni Paolo II 132, 84084 Fisciano (SA), Italy*

[b] *Department of Information, and Electrical Engineering and Applied Mathematics, University of Salerno, Via Giovanni Paolo II 132, 84084 Fisciano (SA), Italy*

[c] *Department of Electrical and Information Engineering "Maurizio Scarano", University of Cassino and Southern Lazio, Viale dell'Università, 03043 Cassino (FR), Italy*

e-mail: nmorante@unisa.it

The epoxidation of propylene to produce propylene oxide (PO) plays a crucial role in the industrial production of numerous compounds and in the synthesis of several intermediates of great interest [1]. On the other hand, the current production processes of the PO present significant problems with respect to the environment and the economy, not guaranteeing their sustainability [2-4].A solution to these problems is represented by the direct photo-epoxidation of propylene using molecular oxygen. In fact, heterogeneous photocatalytic oxidation has been widely used for water and air depollution processes, and it can also be used for carrying out partial oxidation reactions for the synthesis of compounds of interest. It is a sustainable and cost-effective methods conducted under mild conditions using a semiconductor as photocatalyst irradiated by UV or visible light and in presence of atmospheric oxygen [5]. For these reasons, the photo-epoxidation process offers multiple benefits, including the use of a simple technology, low-cost and environmental friendliness.

The aim of this work was to analyze the performances of a photocatalytic system irradiated by UV light for PO synthesis, using a titania-metal based photocatalyst.

Propene oxidation has been studied in the range 25-100 °C into a fluidized bed photocatalytic reactor (FBPR) irradiated by 240 dimmable UV-LEDs. Figure 1 reports the laboratory plant developed for the tests (a) and an image of the photoreactor (b).

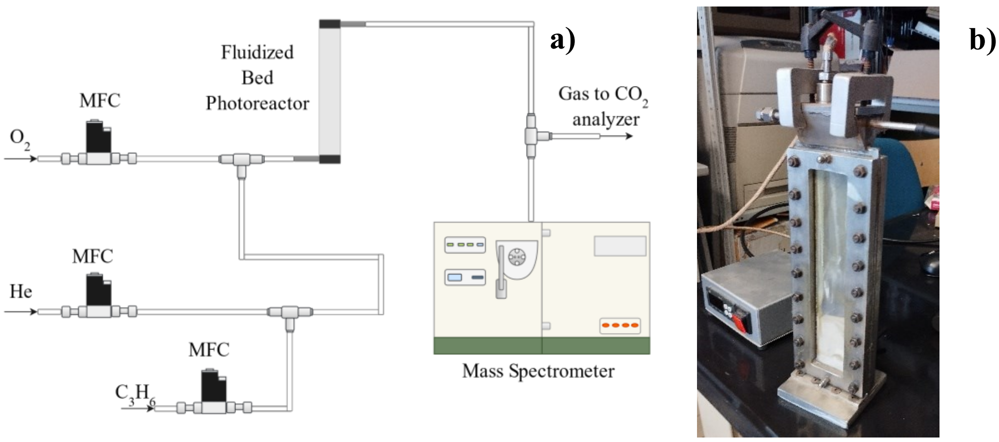

Figure 1: a) scheme of the experimental setup; b) picture of the FBPR.

The epoxidation reaction carried out in a fluidized bed reactor has various advantages: the enhancement of heat and mass transport rate, the uniformity of the intensity of the light incident on the photocatalytic particles, and the minimization of photocatalyst deactivation phenomena [6]. The LEDs dimming permits a modulation of the UV light intensity that could be favorable to energy saving. The photocatalyst used for the experimental tests was synthesized by sol-gel method. The photocatalyst was characterized through Raman, N_2 adsorption at 77 K, ZPC, and UV-DRS analyses, evidencing the presence of the anatase phase. The photocatalytic performances of the photocatalysts will be discussed.

References

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